

Research Editorial

Advancing the Art and Science of Dietary Assessment through Technology

BEVERLY McCABE-SELLERS, PhD, RD

The dietetics profession stands at an important crossroads in the advancement of technological applications to dietary assessment and to new wide-sweeping approaches to dietetics practice, nutrition research, and food and health policy, which are evolving as the profession moves to individualized or personalized nutrition. While dietetics practitioners (registered dietitians [RDs]/dietetic technicians, registered [DTRs]) have long individualized diet plans for patients diagnosed with diabetes or other diseases or conditions requiring medical nutrition therapy, individualization of nutrition is now aimed at optimal nutrition for health and not solely at prevention of nutrient deficiency or at disease treatment (1). The Institute of Medicine of the National Academies has published a series of six Dietary Reference Intake reports covering a total of 45 nutrients, energy, and other food components, and two reports describing ways to apply the Dietary Reference Intakes in assessment and planning (2-8). The Institute of Medicine has issued >450 research recommendations and brought experts together to discuss these research recommendations and optimal dissemination methods. Six continuing knowledge gaps were identified in 2007 as needs for future research: 1) requirements of children, pregnant and lactating women, and the elderly; 2) individual variation of requirements caused by genetics and epigenetics, lifestyle, environment, and/or geography; 3) the need for biomarkers that can predict functional outcomes and chronic diseases; 4) the need to improve dietary assessments and planning methods; 5) bioavailability; and 6) interactions among nutrients (9).

The need to improve dietary assessments and planning methods, the need for biomarkers, and individual variation of requirements caused by genetics, lifestyle, environment, and geography are critical challenges facing the future practice of dietetics. All are dependent on improv-

ing dietary assessment methodology in order to conduct the scientific research to produce evidence-based individualization of dietary recommendations. Diet and food intake have largely been ignored in many research studies, especially drug studies and genetic studies, because of the perceived lack of accuracy of methods (10). No published set of criteria for degree of accuracy required in genetic studies of free-living human beings have been found to date. Diet histories, whether 24-hour dietary recalls, 3-day or 7-day diet records, typical-day intake history, or food frequency questionnaires, have often been dismissed as too inaccurate or unreliable for use by scientists in a variety of disciplines. Lack of memory about what was eaten today, yesterday, or last month is one reason for incompleteness of dietary recalls. A number of aids to jog memory have been proposed, including three to six multiple passes through the previous 24-hour period, complete with standard prompts by the interviewer and portion tools, eg, photographs, food models, measuring cups, actual food packages (11-14). The inability to estimate portion size can be another problem because the interviewee has to perceive and conceptualize the portion size consumed as well as remember foods consumed (11). Given the many limitations of interviewing free-living human beings, some of whom are being seen for medical nutrition therapy after receiving a chronic disease diagnosis, dietetics practitioners using standardized procedures may struggle to obtain good information on which to base nutrition care plans. Whatever method is used to obtain clinical data, however, requires attention to detail not only by the patient but also by the RD/DTR. Methods that reduce the effort required and improve accuracy of both patient and RD/DTR assessment will be truly valuable. Such an approach is proposed by Subar and colleagues in this issue, where they support online reporting of intake, thereby bypassing the effort of a live interviewer, and utilize visual images depicting various portion sizes on the computer screen to improve estimation of amounts eaten.

Computer applications have enhanced the technical abilities of RDs/DTRs in their daily practice, but perhaps less in clinical and community dietetics than in food service and research dietetics, the latter having become highly dependent on computerization of their operations. Processing of nutrient data has probably benefited from computerization more than any other area of the dietetics profession. Recognizing the potential benefit and difficult challenges involved in using nutrient data in practical day-to-day operations, leaders in the field initiated a formal organization to guide development of this application. The Nutrient Databank Conference was begun in 1976 to bring together government scientists, university

B. McCabe-Sellers is a research nutritionist, US Department of Agriculture, Agricultural Research Service, Delta Obesity Prevention Research Unit, Little Rock, AR.

Address correspondence to: Beverly McCabe-Sellers, PhD, RD, US Department of Agriculture, Agricultural Research Service, Delta Obesity Prevention Research Unit, 900 S. Shackleford Rd, Suite 509, Little Rock, AR 72211. E-mail: bev.mccabe-sellers@ars.usda.gov

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researchers, food industry scientists, computer developers, software engineers, and health care practitioners who develop, maintain, apply, or use food composition data. This networking organization has united many of the professionals who have developed nutrient analysis software programs, enabled nutrition labeling to be accomplished, improved dietary methodology for national nutrition surveys and other research studies, and created the demand and resources for updating and expanding the food composition databases. In 2006, this group met as a satellite conference to the American Dietetic Association's Food & Nutrition Conference & Expo with the theme, "The Role of Food Composition in Improving Dietetic Practice." A summary review of the meeting highlights important advances and sources of food composition data, considerations for use and maintenance of databases in a changing food supply, the synergy between food composition data and dietary assessment, and selection of a dietary assessment system (15). Articles presented at the National Nutrient Databank Conferences are often published as a supplement to the *Journal of Food Composition and Analysis* and frequently provide an overview of new technological applications under development. Development of new tools for dietary assessment usually involves an iterative process and consumes resources at levels that only government can justify and generate. The US Department of Agriculture (USDA) has been funding and developing food composition data for >100 years (16). More recently, the USDA and the National Institutes of Health have jointly supported food composition data analysis and methodology development with the formation of the National Food and Nutrient Analysis Program to provide funding and expertise (17-19). The urgent message about need for food composition data and dietary assessment methodology so well articulated by Ershow has led to increased funding and research (18). One example is the development of a food composition database for bioactive food constituents not previously recognized as a nutrient yet possessing important bioactivity (eg, flavonoids) (20). Other examples include the recently released dietary supplement ingredient database and research involving use of cellular telephone technology as a potential means of "real-time" dietary intake assessment (21,22). Children's preferences lean toward self-administered technology application, such as mobile phones or disposable cameras, rather than oral interviews (22). Notable among these recent developments is the automated self-administered 24-hour recall, which contributes to the accuracy of computer-based food photography to solicit portion data in dietary assessment. The efforts of Subar and colleagues represent government scientists, university researchers, and private businesses working together to further dietary assessment through improving accuracy of portion size estimates.

Portion-size estimates are important in research studies and in clinical practices, as large portions can contribute to the obesogenic dietary environment of low-income minority children and their parents (23). Larger portion-sized snacks, sandwiches, restaurant meals, and beverages appear to result in higher total food intake (24-26). Other studies suggest that energy density of foods affects energy intake across multiple levels of fat content in lean

and obese women and across children's intakes of large and self-selected portion sizes (27-29). These studies were conducted with preweighing of food or by using foods of known weights and postweighing the residue. Such feeding studies, however, are time-consuming and expensive, especially when conducted in free-living populations. Having a means of better estimating portion sizes from visual images generated by the user that are linked to a nutrient database makes obtaining accurate dietary assessment more practical and useful in other settings.

Food composition databases have improved in accuracy with better analytical methodology, development of standard reference materials for quality control, use of sound sampling procedures and statistical analyses, and shortened lag time between food analysis completion and ability to access the newer data added to a database (30-35). When comparisons were made among four food composition database values and chemical composition analyses in the Dietary Approaches to Stop Hypertension clinical feeding trial, food values varied <5% (36). If computerization of dietary recalls and use of cellular technology for food intake become fully validated and incorporated into dietetics research and practice, the dietetics profession could move into a new era and become better equipped for sorting out diet-and-gene interactions. This would mean that more evidence for genetic influence on obesity described recently in large twin studies could generate more effective means of modifying the nutrition environment to prevent and treat obesity-related diseases (37,38). Then perhaps the movement toward individualizing nutrition recommendations, assessing disease risk, and making dietary recommendations could begin (39-41).

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